Effects of Soil Fertility on the Incidence and Severity of Coffee Leaf Rust (*Hemileia vastatrix*)

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Introduction

Hemileia vastatrix is a parasitic fungus causing coffee leaf rust (CLR), a disease having widespread detrimental effects on coffee producers globally. Since 2012, the disease has had sweeping impacts on production in Central America and México where producers' yields and incomes have been significantly reduced.

Drawing from research in Brazil and Colombia, CLR has evolved relatively quickly, and complex races of the pathogen have been shown to break down the resistance genes proceeding from *C. canephora* used in *C. arabica* breeding (Avelino, 2016). A similar evolution is likely to occur in Central America where an increasing presence of resistant varieties is predicted to have high selection pressure on the pathogen (Avelino, 2016). Taking this into account, resistant varieties cannot be considered as a standalone solution to combat rust; they should be accompanied by management strategies that limit the presence of the disease through comple-mentary mechanisms (Avelino, 2016).

Fertilizer applications seem to be critical, but little research has been conducted on the effects of the relationships between soil fertility management, coffee plant nutrition, and physiological resistance to rust (Avelino, 2016).

Objectives

The research objective is to understand the effects of soil health on coffee leaf rust as a basis for developing Best Management Practices and new training programs for technicians and producers.

Timeline	2016	2017			2018		2019
Characterization study in Honduras, Guatemala, and México	Field work **Phase I** (Preharvest)	Field work **Phase II** (Postharvest)	Analysis, preliminary report on the first year of the survey	Field work **Phase I** (Preharvest)	Field work **Phase II** (Postharvest)	Analysis, second preliminary report	Analysis and final report
Laboratory trial in Costa Rica	Nursery establishment	Trial, analysis, and final report					
Laboratory trial in Honduras		Nursery establishment			Trial, analysis, and final report		

Methods

In June 2016, CRS began working with CATIE and regional partners Promecafe, IHCAFE, and GAIA to conduct research that measures interactions between soil nutrient availability and coffee leaf rust disease presence at plots in Honduras, Guatemala, and México.

To study soil-rust interactions in a field setting, we use a subset of ~300 coffee plots among plots involved in CRS's Agricultura, Suelos, Agua (ASA) programming (~175 in Honduras, ~75 in Guatemala and ~50 in México). In each plot, CRS technicians and partner organizations collect data from both a subplot managed with fertilizer treatments and a control subplot managed by the producer as usual. As a result, the research study will have ~600 coffee plots under observation.

In addition to existing chemical soils baseline data manged by CRS, we trained technicians and smallholder producers in collecting data for the following variables: variety, density, plant age, cropping practices applied during the studied year, branch growth, defoliation, rust incidence, rust severity, fruit load, shade type, and shade cover. Most of these variables need to be considered because of their potential effects on CLR incidence.

1) Dominant variety in the subplot

2) Plant density within the subplot

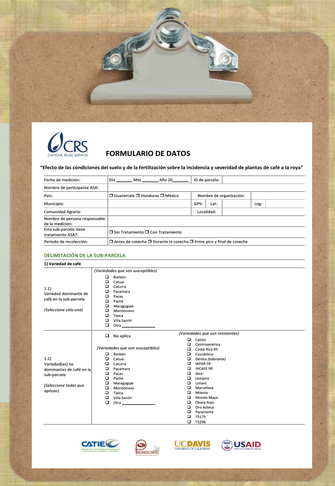
Obtained from farmer interview

3) Age of majority of coffee plants within the subplot

4) Management practices during the current year

Obtained by technician

- 5) Branch growth
- 6) Defoliation
- 7) Rust incidence
- 8) Rust severity
- 9) Fruit load
- 10) Shade type
- 11) Shade cover

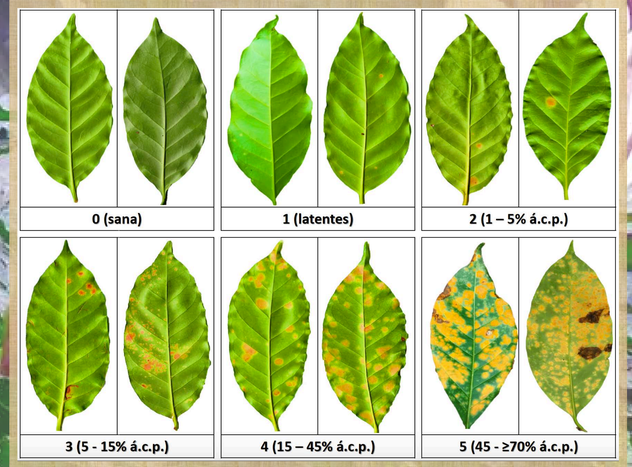


FORMULARIO DE DATOS

"Efecto de las condiciones del suelo y de la fertilización sobre la incidencia y severidad de plantas de café a la roya"

Expected Outputs

- A better understanding of the effects of soil health on CLR to the scientific and technical community;
- Value to producer livelihoods in being conducted by Catholic Relief Services, whose objective is that the results of the study are significant and useful to smallholders.



Upcoming Work

- Phase II (2017) of field work;
- Data bases on rust incidence and severity coming from field surveys and laboratory trials;
- At least two scientific open-access publications on the relationships between soil health and coffee rust;
- One technical publication on best practices for managing coffee rust in each country involved.

References

Avelino, J., (2016). "Effects of coffee nutrition on coffee rust" project proposal.

Avelino, J., et al. (2006). The intensity of a coffee rust epidemic is dependent on production situations. Ecological Modelling 197(3-4): 431-447

Avelino, J., Rivas, G. (2013). La roya anaranjada del cafeto. 47. <hal-01071036>.

Dordas, C. (2008). Role of nutrients in controlling plant diseases in sustainable agriculture. A review. Agronomy for Sustainable Development. 28 (1): 33-46.

Ferrandino, F.J. (2008). Effect of crop growth and canopy filtration on the dynamics of plant disease epidemics spread by aerially dispersed spores. Phytopathology. 98 (5): 492-503.

Martinati, J.C., Harakava, R., Guzzo, S.D., y Tsai, S.M. (2008). The potential use of a silicon source as a component of an ecological management of coffee plants. Journal of Phytopathology. 156 (7-8):458-463.

Santos, F.d.S., de Souza, P.E., Pozza, E.A., Miranda, J.C., Carvalho, E.A., Fernandes, L.H.M., y Pozza, A.A.A. (2008). Organic fertilization, nutrition and the progress of brown eye spot and rust in coffee trees. Pesquisa Agropecuaria Brasileira. 43 (7): 783-791.